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Original Research

Does fibula fracture have an impact on tibial healing?

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Abstract
Aim: Tibial diaphysis fractures are frequently-encountered fractures of the lower extremities. Fibula fracture may accompany these fractures. In this study, we investigated the effects of accompanying fibula fracture on the healing of tibial diaphysis fractures, which were treated by intramedullary nail fixation.
Materials and Methods: Data of the patients who presented to our clinic and underwent intramedullary nailing for tibial diaphysis fractures between January 2016 and December 2018 were reviewed. Patients were divided into two groups based on the presence (Group 1) or absence (Group 2) of accompanying fibula fracture. Database which included information such as fracture type (open or closed fracture), fracture healing time, angulation, and smoking history were retrospectively analyzed. The effect of accompanying fibula fracture and other parameters on the healing time following intramedullary nail fixation of tibia diaphysis fractures was investigated. The Shapiro-Wilk, the Mann-Whitney U, and the Chi-Square tests were used for statistical analysis.
Results: One hundred twenty-eight patients were included in this study. Among these patients, 101 had accompanying fibula fracture while 27 had intact fibula. Fracture healing times were significantly shorter in the latter group (p=0.001). However, there was no statistically significant difference between the groups in terms of fracture angulation except for valgus angulation. Smoking history and the presence of open or closed fracture did not have a significant impact on outcomes (p=0.249).
Discussion: Intact fibula shortens the healing time after intramedullary nail fixation of tibia diaphysis fracture.

Keywords
Tibia fracture; Fibula; Intact fibula; Intramedullary nail

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Introduction

Tibia diaphysis fractures are often encountered in orthopedics practice [1]. It has been long wondered whether accompanying fibula fracture had an impact on the healing of the tibia fractures [1, 2]. It is known that several factors affect the healing of tibia diaphysis fracture, but there is a debate regarding whether to nail the fibula in accompanying fibula fracture or not [1, 2]. While some studies have suggested that fixing the accompanying fibula fracture increases the stability, some other studies have shown that fixation of fibula fracture balances the axial loading strength, but it cannot not provide torsional stability [3,4]. In a study where tibia diaphysis fractures were fixed by plates in cadavers, it was concluded that fixing or not fixing the fibula was not superior to each other in terms of outcomes [5]. These different findings reported in the literature implies that further studies are needed in this subject. In this study, we aimed to investigate the effects of accompanying fibula fracture on fracture healing times and fracture angulations in tibial diaphysis fractures treated by intramedullary nailing.

Material and Methods

In this study, data of the patients who underwent intramedullary nail fixation for tibial diaphysis fracture at our centre between January 2016 and December 2018 were retrospectively analyzed. Patients with a pathological fracture, patients who were lost to follow-up, and had incomplete data were excluded. All patients had a follow-up period of at least one year. The mean follow period was 22.3 months (12-56 months). Fracture healing times were calculated by reviewing periodically taken X-ray graphics of the patients; healing was defined as 'healing of at least 3 of 4 cortices'. Patients were divided into two groups based on the presence or absence of accompanying fibula fracture (Figures 1 and 2). Groups were compared in terms of age, gender, smoking history, fracture type, angulation, persistent infection, and healing time.

The design and protocol of this retrospective study were approved by the Institutional Review Board at Gaziantep University.

Statistical analysis

The Shapiro-Wilk test was used for testing the normality of numerical data. The Mann-Whitney U test was utilized for comparison of the not normally distributed data between the groups. The relationship between categorical variables was analyzed by the Chi-square test. The SPSS 22.0 Windows software was used for all statistical analyses. A p-value of less than 0.05 was considered statistically significant.

Results

Our retrospective analysis revealed that 135 patients underwent intramedullary nailing procedures for the treatment of tibial diaphysis fractures during the study period. However, 128 of these patients were included after application of exclusion criteria. The mean patient age was calculated as 32, 82 (18-76).

Among all study patients, 98 (76,5%) were male, while 30 (23,5%) were female. Analysis in terms of fracture type revealed that 83 (64,8%) of the fractures were closed, while 45 (35,2%) were open. Open fracture subtypes differed between type 1 and type 3A. In total, 68 (53,1%) patients had a history of smoking. All tibial fracture levels were in the diaphysis. Seventy of 101 fibula fractures (%70) were placed in distal third, 23 (%23) were placed in fibula shaft and 8 (%8) were placed in proximal third. All the intramedullary nails were reamed nails. All patients were operated by the same surgeon. Nonunion was not seen in our follow-up period.

A comparison of the two groups revealed no statistically significant difference in terms of gender distribution, fracture type, and smoking history (Table 1). However, the mean age of the patients was significantly higher in the patient group with accompanying fibula fracture (p=0,033).

While in Group 1 there were 77 (76,9%) male and 24 (23,1%) female patients, in Group 2 there were 21 (77,8%) male and 6 (22,2%) female patients. The mean fracture healing time was calculated as 3.6 months and 2.85 months in Group 1 and Group 2, respectively (p=0,001). Fracture healing time was found out to be significantly longer in patients with accompanying fibula fracture (Group 1) both in age-adjusted and unadjusted analyses (p=0,001). Recurvatum rates were not significantly different between the groups in the age-adjusted analysis (p=0,056). On the other hand, the rate of valgus angulation was significantly higher in the patient group with accompanying fibula fracture (Group 1) in the analysis unadjusted for age (p=0,039); while there was no difference in age-adjusted analysis. Also, there was no difference in terms of other parameters (Table 2). There was no persistent infection in two groups. Dynamisation was not performed in any patient in two groups.

Table 1. Parametres and statistical analysis

		Groups				
		Group 1 (Fibula fractured) (n=101)		Group 2 (Fibula is intact) (n=27)		
		Number	Percentage (%)	Number	Percentage (%)	p value
Gender	Male	77	76.2	21	77.8	0.867
	Female	24	23.8	6	22.2	
Smoking history	Positive	51	50.5	17	63.0	0.249
	Negative	50	49.5	10	37.0	
Fracture type	Open	34	33.7	11	40.7	0.494
	Closed	67	66.3	16	59.3	

Table 2. Analysis of two groups

	Group 1 (Fibula fractured) (n=101)		Group 2 (Fibula is intact) (n=27)			
Variables	Mean±SD	Median [min-max]	Mean±SD	Median [min-max]	p value	p value (Age-adjusted)
Age	33.99±14.22	31 [14-76]	28.11±12.2	27 [16-58]	0.033*	
Healing time	3.68±1.65	3 [1-12]	2.85±1.46	2 [2-9]	0.001*	0.018*
Procurvatum	1.24±2.95	0 [0-14]	0.96±2.17	0 [0-9]	0.911	0.988
Recurvatum	1.28±2.27	0 [0-10]	0.36±1.22	0 [0-6]	0.056	0.050
Varus	0.89±2.39	0 [0-14]	0.22±0.51	0 [0-2]	0.583	0.204
Valgus	1.82±2.41	1 [0-10]	0.84±1.68	0 [0-6]	0.039*	0.059

*Statistical difference is significant (p<0.05); Mann-Whitney U test. Age-adjusted p values were calculated by generalized linear model

Figure 1. Tibial shaft fracture with intact fibula

Figure 2. Tibial shaft fracture with non-intact fibula

Discussion

Intramedullary nail fixation is frequently performed for the treatment of tibial diaphysis fractures [6]. Intramedullary nails function is based on relative stability principle and supports healing via secondary bone healing mechanism. They have advantages such as minimal invasiveness, easy applicability, and they do not lead to morbidities in the fracture field. As additional advantages, nails can be used in the presence of accompanying injuries or complicated fractures such as Gustilo-Anderson type 3a [7]. There is a debate in the literature regarding the treatment outcomes of tibia fractures without accompanying fibula fracture [8-10]. While some studies have proposed that an intact fibula causes a delay in the healing of the tibial fracture, some other studies have reported that it increases the stability of the tibial fracture and fastens its healing [8-10].

Biomechanically, fibula has been traditionally viewed as a static lateral strut for the talocrural joint that provides the origin for several muscles of the foot [8-10]. Some studies have demonstrated load transfer through the interosseous membrane, which connects the tibia and fibula [11-13]. It is known that fibula carries 3-16% of the load imposed on the lower extremities [11]. There are reports which demonstrated that an intact fibula or post-fracture fixed fibula could accelerate the healing of the same-level tibial fracture [12]. In a study that investigated the need for fixation of the fibular fracture in this setting, authors suggested that both the severity of soft tissue injury and the healing capacity of the fibular fracture without fixation should be considered. However, results suggest that for midshaft tibial fractures, fibular plating may not effectively restore the tibial stability produced by an intact fibula and should not be performed unless fibular fixation is otherwise indicated [14]. In another study that investigated the effects of accompanying fibula fracture on the healing of tibial diaphysis fractures, it has been denoted that an intact fibula did not constitute a disadvantage for healing after intramedullary nailing and did not have any influence on the healing and angulation rates [2].

There are several factors affecting fracture healing [1, 2]. Fracture type (open vs. closed), location, accompanying injuries, and smoking history are among the most critical factors. However, outcomes of the surgical treatment of tibial diaphysis fractures are usually satisfactory; load can be imposed in the early period, and there is no need for postoperative brace use [3, 4].

Maintenance of the ideal alignment of the extremity is essential

following fracture fixation, and intramedullary nails can overcome this problem to a large extent. However, we detected angulations in both patient groups in our study; the presence or absence of an accompanying fibula fracture did not lead to a difference in angulation rates.

Unlike other studies, in our study, open fractures were also included. Balaji et al. reported that open tibial diaphysis fractures with an intact fibula had a longer healing time [15]. We did not find any difference in healing times in our study.

Our study has some limitations which should be taken into consideration. It is a retrospective study that could have been affected by inherent weaknesses stemming from its retrospective design. As another limitation, the number of patients without accompanying fibula fracture (Group 2) was significantly low. This difference might have led to bias. Besides, only patients who were treated by intramedullary nailing were included, and patients treated by other implants were not recruited. This selection method was implemented with the expectation of achieving a homogeneous study group at the expense of reducing the total number of study patients. Another limitation is that the tibial shaft fractures were not analyzed according to AO classification. Spiral oblique or transverse or the other types of fractures may affect healing time results.

Conclusion

Treatment of tibial diaphysis fractures with or without accompanying fibula fractures using intramedullary nailing leads to encouraging outcomes. An intact fibula can shorten the healing time; however, it does not have any effect on angulation rates.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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